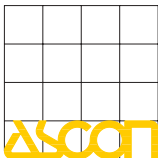


ISO9001 Certified



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## mod. IO-MB/DI-16LV

M.U. IO-MB/DI-16LV-3/09.02  
Cod. J30-658-1ADI-16LV E

## User manual

### Contents

- Characteristics
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### APPLICABLE STANDARDS

The DI-16LV module is suited for the Modbus-IDA Organization protocol [1] and implements a subset of it, as explained in the text. MODBUS is a registered trademark of Schneider Automation Inc.

### Characteristics

#### Technical data

|                              |                |
|------------------------------|----------------|
| Number of channels           | 16             |
| Polarity (EN 61131-2 type 2) | Sink           |
| UL (state 0)                 | -3...+11/5 Vdc |
| UT (transition)              | 5...11 Vdc     |
| UH (state 1)                 | 11... 30 Vdc   |
| Input impedance              | 5 kΩ           |
| ON/OFF delay                 | 5 ms           |
| Max. monostable time         | 65 s           |

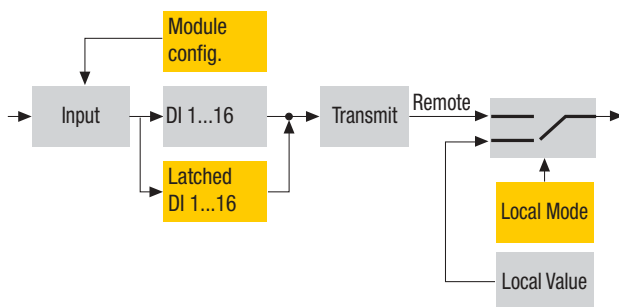
### General

|                                 |                                                                                                               |
|---------------------------------|---------------------------------------------------------------------------------------------------------------|
| 3 way isolation (see last page) | Ch. to ch.: no isolation; ch. to logic: 800 Vp<br>serial bus to logic: 800 Vp; power supply to logic: 2.5 kVp |
| Power supply                    | 24 Vdc; -15...+25% Consumption: 3 W                                                                           |
| Overvoltage protection          | 40 Vdc                                                                                                        |
| Dimensions                      | L: 76; H: 110; W: 65; Weight: 220g                                                                            |
| Safety regulations              | Isolation class II (50 Vrms), Installation category II                                                        |
| EN61010-1                       | Pollution degree 2                                                                                            |
| CE marking                      | EN61131-2                                                                                                     |

### Environment

|                     | Operating                                                                          | Storage                                                                                     |
|---------------------|------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| Temperature         | -10...+65°C                                                                        | -40...+85°C                                                                                 |
| Relative Humidity   | 5...95% non condensing<br>Appropriate measures must be taken against humidity >85% | 5...95% non condensing<br>For a short period, slight condensation may appear on the housing |
| Mounting            | Vertical, free air                                                                 |                                                                                             |
| Protection          | IP20                                                                               |                                                                                             |
| Vibrations (3 axes) | 10...57Hz 0.0375mm, 57...150Hz 0.5g                                                |                                                                                             |
| Shock (3 axes)      | 15g, 11ms half sine                                                                |                                                                                             |

### Functional Block Diagram



## MODBUS I/O module

### 16 Isolated Digital Inputs

## mod. IO-MB/DI-16LV



### 16 optoisolated digital inputs with special functions

- Latched inputs.

### WARNING

The product described in this manual should only be installed, operated and maintained by qualified application programmers and software engineers who are familiar with automation safety concepts and applicable national standards.

### Function Codes used by the module

|             |             |                              |                          | Functions | (hex) |
|-------------|-------------|------------------------------|--------------------------|-----------|-------|
| Data access | Bit access  | Physical Digital Inputs      | Read Inputs status       | 02        | 02    |
|             |             | Internal Bits Or             | Read Coil status         | 01        | 01    |
|             |             | Physical Digital output      | Write Single Coil        | 05        | 05    |
|             | Word access | Physical Input Registers     | Write Multiple Coils     | 15        | 0F    |
|             |             | Internal Registers           | Read Input Register      | 04        | 04    |
|             |             | Or Physical Output Registers | Read Holding Registers   | 03        | 03    |
| Diagnostics |             |                              | Write Single Register    | 06        | 06    |
|             |             |                              | Write Multiple Registers | 16        | 10    |
|             |             |                              | Read Exception status    | 07        | 07    |
|             |             |                              | Diagnostics              | 08        | 08    |

The function codes provided for all the modules are a subset of the "Public Function Codes", validated by the Modbus-IDA Organization.

Function 01 and Function 02 can be used to read both digital output and digital input. Function 03 and Function 04 can be used to read both output and input registers.

### Diagnostics

#### MODBUS Exception Responses:

| Code | Name                       | Meaning                                                                                                                                   |
|------|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| 01   | ILLEGAL FUNCTION           | The function code received in the query is not an allowable action for the server (or slave)                                              |
| 02   | ILLEGAL DATA ADDRESS       | The data address received in the query is not an allowable address for the server (or slave).                                             |
| 03   | ILLEGAL DATA VALUE         | A value contained in the query data field is not an allowable value for server (or slave)                                                 |
| 07   | NEGATIVE ACKNOWLEDGE - NAK | The server (or slave) is in the wrong state to process a request of this type or an attempt to write to a read only address has been made |

Code 07 has not been provided by Modbus.org Protocol. Use it for ASCON products compatibility only.

#### Function Code 07: Read Exception Status:

| bit    | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|--------|---|---|---|---|---|---|---|---|
| status | 0 | 0 | 0 | X | X | X | X | X |

Digital Input writing attempted (1) → bit 4  
 Dummy Data Field (0 fill) (1) → bit 3  
 Output Data Valid (1) → bit 2  
 Local Value state (1) → bit 1  
 Invalid Input Data (1) → bit 0

#### Function Code 08: Diagnostics

The only supported sub code is 0 – Return Query Data

## MODBUS Address Map organisation

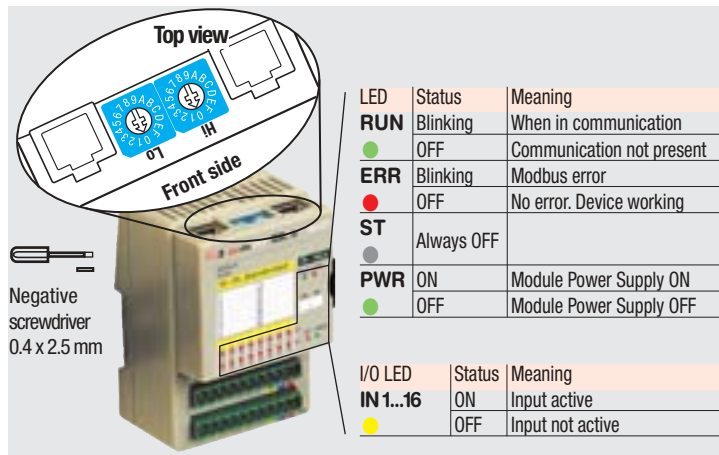
| Data Type   | Address Range | Sub range   | Data sub type                   |
|-------------|---------------|-------------|---------------------------------|
| Digital I/O | 1 - 400       | 1 - 100     | Physical Digital I/O            |
|             |               | 101 - 200   | Digital I/O Extension           |
|             |               | 201 - 300   | Alarms                          |
|             |               | 301 - 400   | Status variables                |
| Registers   | 1 - 1200      | 1 - 120     | Field/Process I/O Data          |
|             |               | 121 - 200   | Device Id/Info Area             |
|             |               | 201 - 300   | Field/Process I/O Extension     |
|             |               | 301 - 400   | Non retentive Device Management |
|             |               | 401 - 800   | Retentive Device Management     |
|             |               | 801 - 1000  | Configuration Data              |
|             |               | 1001 - 1050 | Diagnostics                     |
|             |               | 1101 - 1200 | Reserved registers              |

### Writing and reading data length limits:

|                                                              |          |
|--------------------------------------------------------------|----------|
| Number of Digital Outputs to be written in a single message  | Max. 128 |
| Number of Digital I/O to be read in a single message         | Max. 160 |
| Number of Output Registers to be written in a single message | Max. 16  |
| Number of I/O Registers to be read in a single message       | Max. 125 |

## Hardware Set-up

### Hexadecimal rotary switches, service and I/O LEDs



## Baud Rate and Node ID configuration

### Baud Rate

| Lo switch | Baud rate bps |
|-----------|---------------|
| 0         | 300           |
| 1         | 1200          |
| 2         | 2400          |
| 3         | 4800          |
| 4         | 9600          |
| 5         | 19200         |

### Node ID

| Hi switch | Lo switch | Valid ID Node      |
|-----------|-----------|--------------------|
| 0         | 1         | 1 (address 1)      |
| 0         | 2         | 2 (address 2)      |
| ↓         | ↓         | ↓                  |
| F         | 7         | 0xF7 (address 247) |

## Procedure for Node Address and Baud Rate configuration

The HI and LO hexadecimal rotary switches set the module's Baud Rate and MODBUS Node Address. To configure the module, follow the procedure:

- 1 Turn the Power OFF
- 2 Set the **HI** and **LO** switches to "F"
- 3 Turn the Power ON
- 4 Select the desired Baud Rate value by setting the **LO** switch following the table (e.g. "4" for 9600 bps)
- 5 Shift the **HI** switch to "E" (all the module service LEDs should flash)
- 6 Turn the Power OFF. Now configure Node ID
- 7 Set the **HI** and **LO** switches to the desired valid Node ID following the table
- 8 Turn the Power ON.

Alternatively, at step 7 set the value 00h (default value). Then, at the next Power ON, the last valid stored value will be resumed as Node ID. The default values are: Baud Rate = 9600 bps, Node ID = 247.

## Common parameters

### Common Digitals

| Digital outputs | Name    | Access | Notes                                    |
|-----------------|---------|--------|------------------------------------------|
| 397             | Parity  | R/W    | <b>0:</b> Disabled;<br><b>1:</b> Enabled |
| 398             | EvenOdd | R/W    | <b>0:</b> Even;<br><b>1:</b> Odd         |

### Common Registers

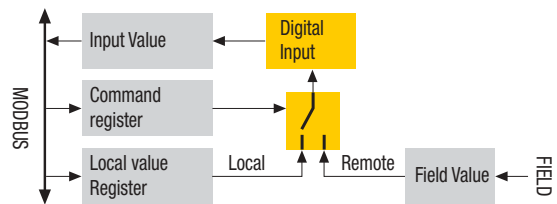
| Output Registers | Name                                                                                                                                                  | Access | Notes                                                  |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|--------|--------------------------------------------------------|
| 398              | Ch_LO                                                                                                                                                 | R/W    | Channel Number 8-1 enable for ModuleCom (see reg. 399) |
| <b>bit</b>       | <b>15</b> <b>14</b> <b>13</b> <b>12</b> <b>11</b> <b>10</b> <b>9</b> <b>8</b> <b>7</b> <b>6</b> <b>5</b> <b>4</b> <b>3</b> <b>2</b> <b>1</b> <b>0</b> |        |                                                        |
| Channel          | 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1                                                                                                                |        |                                                        |

| Output Registers | Name      | Access | Notes                   |
|------------------|-----------|--------|-------------------------|
| 399              | ModuleCom | R/W    | Module Command Register |

### Commands:

|                          |                                                            |
|--------------------------|------------------------------------------------------------|
| 0x0                      | Normal State (all channels)                                |
| 0x4C42 (ASCII code "LB") | Local Value State (only for enabled channels see reg. 398) |

How Local Value Command works (valid for Channel Number Bit = 1)



| Output Registers | Name     | Access | Notes                         |
|------------------|----------|--------|-------------------------------|
| 400              | StackCom | R/W    | Modbus Stack Command Register |

**Commands:**

|                          |                                            |
|--------------------------|--------------------------------------------|
| 0x0                      | Normal State                               |
| 0x5354 (ASCII code "ST") | Store Configuration in non volatile memory |
| 0x5253 (ASCII code "RS") | Restore default configuration values       |
| 0x5254 (ASCII code "RT") | RESET (Cold Start)                         |

| Output Registers | Name  | Access | Notes                 |
|------------------|-------|--------|-----------------------|
| 801              | NodeA | R/W    | Node Address Register |
| 802              | BaudR | R/W    | Baud Rate Register    |

| Baud Rate | Register Value | Node Address      | Register Value |
|-----------|----------------|-------------------|----------------|
| 300       | 0              | 0 reserved        | 0              |
| 1200      | 1              | 1                 | 1              |
| 2400      | 2              | ...               | ...            |
| 4800      | 3              | ...               | ...            |
| 9600      | 4              | 247               | 0xF7           |
| 19200     | 5              | 248..256 reserved | 0xF8...0xFF    |

## Module Identity Registers

| Output Registers | Name        | Access | Notes                 |
|------------------|-------------|--------|-----------------------|
| 121              | ManuCode    | R      | Manufacturer Code     |
| 122              | ProdCode-1  | R      | Product Code # 1      |
| 123              | ProdCode-2  | R      | Product Code # 2      |
| 124              | RelCode-1   | R      | Hardware Release Code |
| 125              | RelCode-2   | R      | Software Release Code |
| 126              | SpecialCode | R      | Special Product Code  |
| 127              | ProdCode-3  | R      | Product Code # 3      |

## User defined Registers

| Output Registers | Name   | Access | Notes                                  |
|------------------|--------|--------|----------------------------------------|
| 189              | Usr#1  | R/W    | User Defined Register # 1 (retentive)  |
| 190              | Usr#2  | R/W    | User Defined Register # 2 (retentive)  |
| ...              | ...    | ...    | ...                                    |
| 198              | Usr#10 | R/W    | User Defined Register # 10 (retentive) |

## Module parameters

### Standard Inputs

| Digital Inputs | Name  | Access | Notes                               |
|----------------|-------|--------|-------------------------------------|
| 1              | DI-1  | R      | Image of every physical input state |
| ...            | ...   | R      |                                     |
| 16             | DI-16 | R      |                                     |

### Latched Inputs

| Digital Outputs | Name          | Access | Notes                                                                                                                                       |
|-----------------|---------------|--------|---------------------------------------------------------------------------------------------------------------------------------------------|
| 101             | Latched DI-1  | R/W    | <b>Reading:</b> Image of physical Inputs, staticised on the leading edge 0-1 (latch)<br><b>Writing:</b> Writing "0" resets the single latch |
| ...             | ...           | R/W    |                                                                                                                                             |
| 116             | Latched DI-16 | R/W    |                                                                                                                                             |

### Local Values

| Output Registers | Name      | Access    | Notes                                                                                             |
|------------------|-----------|-----------|---------------------------------------------------------------------------------------------------|
| 301              | LocalV    | R/W       | While in Loopback state the 0...15 bits of this register are transferred to 1..16 digital inputs. |
| <b>bit</b>       | <b>15</b> | <b>14</b> | <b>13</b>                                                                                         |
| <b>12</b>        | <b>11</b> | <b>10</b> | <b>9</b>                                                                                          |
| <b>8</b>         | <b>7</b>  | <b>6</b>  | <b>5</b>                                                                                          |
| <b>4</b>         | <b>3</b>  | <b>2</b>  | <b>1</b>                                                                                          |
| <b>0</b>         |           |           |                                                                                                   |
| Channel          | 16        | 15        | 14                                                                                                |
|                  | 13        | 12        | 11                                                                                                |
|                  | 10        | 9         | 8                                                                                                 |
|                  | 7         | 6         | 5                                                                                                 |
|                  | 4         | 3         | 2                                                                                                 |
|                  | 1         |           |                                                                                                   |

## Parameter Store/Restore

This module allows parameters to be saved in a non volatile memory. In order to avoid storing configuration data parameters (registers 801...1000) by mistake, storage is only executed when a specific signature is written to the appropriate register. The signature is "ST".

Similarly, the default values of parameters are restored. On receipt of the correct signature in the appropriate register, the device restores the default parameters. The signature is "RS".

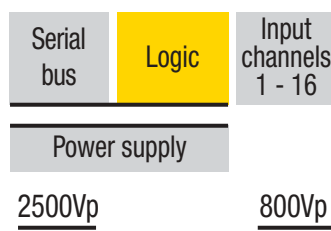
The new configuration becomes active after a reset, i.e. after a "Power Down" or a reset command (signature "RT"). See Register 400.

**es.** Node address change by serial communications:

1. Write the new address in register 801 (NodeA). - Write value.
2. Write 0x5354 (ASCII code "ST") to register 400. - Store value.
3. Write 0x5254 (ASCII code "RT") to register 400. - Cold reset.

The retentive device management data (registers 401... 800) are immediately valid after writing. To maintain the values after a power OFF/ON cycle, the command Store ("ST") must be executed.

## Three way isolation diagram



## MODBUS Map summary (with default values)

| Modbus address | Module digital I/O | Name          | Access | Description                           | default (hex) |
|----------------|--------------------|---------------|--------|---------------------------------------|---------------|
| 0              | 1                  | DI-1          | R      | Input 1                               | 0             |
| ...            | ...                | ...           | R      | Input n                               | 0             |
| 15             | 16                 | DI-16         | R      | Input 16                              | 0             |
| 100            | 101                | Latched DI-1  | R/W    | Latched Input 1                       | 0             |
| ...            | ...                | ...           | R/W    | Latched Input n                       | 0             |
| 115            | 116                | Latched DI-16 | R/W    | Latched Input 16                      | 0             |
| 396            | 397                | Parity        | R/W    | 0: Parity Disabled; 1: Parity Enabled | 0             |
| 397            | 398                | EvenOdd       | R/W    | 0: Parity Even; 1: Parity Odd         | 0             |

| Modbus address | Module registers | Name        | Access | Description                   | default (hex) |
|----------------|------------------|-------------|--------|-------------------------------|---------------|
| 120            | 121              | ManuCode    | R      | Manufacturer Code             | 0258          |
| 121            | 122              | ProdCode-1  | R      | Product Code # 1              | 3136          |
| 122            | 123              | ProdCode-2  | R      | Product Code # 2              | 4C56          |
| 123            | 124              | RelCode-1   | R      | Hardware Release Code         |               |
| 124            | 125              | RelCode-2   | R      | Software Release Code         |               |
| 125            | 126              | SpecialCode | R      | Special Product Code          |               |
| 126            | 127              | ProdCode-3  | R      | Product Code # 3              | 4449          |
| 188            | 189              | Usr#1       | R/W    | User Defined Register # 1     | FFFF          |
| 189            | 190              | Usr#2       | R/W    | User Defined Register # 2     | FFFF          |
| ...            | ...              | Usr#n       | R/W    | User Defined Register # n     | FFFF          |
| 197            | 198              | Usr#10      | R/W    | User Defined Register # 10    | FFFF          |
| 300            | 301              | LocalV      | R/W    | Local values 1...16           | 0000          |
| 397            | 398              | Ch_LO       | R/W    | Channel Number 16-1 selection | 0000          |
| 398            | 399              | ModuleCom   | R/W    | Module Command Register       | 0000          |
| 399            | 400              | StackCom    | R/W    | Modbus Stack Command Register | 0000          |
| 800            | 801              | NodeA       | R/W    | Node Address Register         | 00F7          |
| 801            | 802              | BaudR       | R/W    | Baud Rate Register            | 0004          |

## WARNING

The data written at retentive and configuration registers are stored in EEPROM (see "Address Map organisation" paragraph for details). This type of memory has a limited number of writing cycles. Also if this number is very high (about 100000 cycles), this limit can be easily reached if the storing process is forced through a serial communications line. Please check that the storing procedure of these registers is not performed automatically.

## Reference documents

The user should refer to the following list of documents:  
[1] MODBUS.ORG: MODBUS Application Protocol Specification V1.1a, June 2004

## Accessories, Spare Parts and Warranty

|                                |                    |
|--------------------------------|--------------------|
| Power Supply 45W 24Vdc 2A      | AP-S2/AL-DR45-24   |
| Power Supply 120W 24Vdc 5A     | AP-S2/AL-DR120-24  |
| Additional Terminal Block 2x11 | AP-S2/TB-211-1     |
| Female Plug 11 Screw clamp     | AP-S2/SPINA-V11    |
| Female Plug 11 Spring clamp    | AP-S2/SPINA-M11    |
| RJ45 terminated cable 14cm     | AP-S2/LOCAL-BUS76  |
| RJ45 terminated cable 22cm     | AP-S2/LOCAL-BUS152 |
| Termination Adapter            | AP-S2/TERM-CAN     |

**Warranty: 3 years excluding defects due to improper use**